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Year One Annual Report: Activities, Findings and Evaluators' Reports

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Tushnet, Naida; Hoffman, Jodie L.S.; and Ziobrowski, Jaclyn, "Year One Annual Report: Activities, Findings and Evaluators' Reports" (2005). *Reports to NSF*. Paper 9.

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Year One Annual Report

Activities, Findings and Evaluators' Reports

2004 - 2005



ncete™

**National Center for Engineering
and Technology Education**

www.ncete.org



The material is based on work supported by the National
Science Foundation under Grant No. ESI-0426421

Major Research and Education Activities: 2004-05

The ultimate goal of NCETE is to infuse engineering design, problem solving and analytical skills into 9-12 grades through technology education in order to increase the quality, quantity, and diversity of engineering and technology educators, and to significantly strengthen the pathways to engineering and technology professions for students. The Center is doing this by teaming engineering faculty and technology education faculty in a systematic approach that involves:

1. Building a community of researchers, leaders, and PhD students to conduct research in emerging engineering and technology education areas.
2. Creating a body of research that improves our understanding of learning and teaching engineering and technology subjects.
3. Preparing technology education teachers at the BS and MS level who can infuse engineering design into the curriculum (current and future teachers).
4. Strengthening the pathways for a diverse population of students who select engineering, science, mathematics, and technology careers.

NCETE divided tasks into four components: 1) the Graduate Program Component, 2) the Technology Teacher Education Component, 3) the Research Component, and 4) the Recruiting and Retention Component. Described below are the major research and education activities within each component.

1. Graduate Program Component

The Graduate Program team consisted of investigators from the University of Georgia, the University of Illinois at Urbana Champaign, the University of Minnesota, and Utah State University. The Graduate Program Director was Bob Wicklein from the University of Georgia. The Graduate Program team participated in the following five face-to-face meetings: 1) September 15-16, 2004, at the University of Georgia, 2) December 16-17, 2004, at the University of Minnesota, 3) January 13-14, 2005 in Washington, DC, 4) March 31, 2005, prior to the ITEA Conference, and 5) May 23-26, 2005 at the summer workshop at Utah State. E-mail was used regularly between face-to-face meetings. To further enhance communication, in May 2005, an NCETE intranet site was developed.

Core Course Development. One of the major activities of the Graduate Program team was development of four core courses to be delivered using distance delivery technologies to the doctoral student cohort within NCETE. The core courses will be delivered each semester, beginning Fall Semester, 2005. The core courses will provide the doctoral students with a background in cognitive science with emphasis on design and problem solving, and to provide a background in engineering analysis and design. The core courses as described in the proposal have been modified and improved to better fit the goals of NCETE. Listed below are the responsible institutions and proposed core courses.

- Fall 2005, UIUC, The Role of Cognition in Engineering and Technology Education
- Spring 2006, UMN, Modeling Engineering Design
- Fall 2006, UGA, Engineering Design I
- Spring 2007, USU, Engineering Design II

A template for the core course syllabi was developed and completed for the core courses. Details of how the core courses will be administered and delivered have been established. The Graduate Program team decided the initial offering of the core courses will be limited to the doctoral students at the four doctoral institutions.

Doctoral Students. NCETE has been very successful in recruiting students for the doctoral program. There were 31 applicants and 14 students were selected. Of the 14 fellows, 3 are white females, 2 are African American males and 9 are white males. NCETE attributes the success of the recruiting efforts to the Recruiting and Retention Task Force described below.

On August 18, 2005, the doctoral students will be honored at a reception in Washington, DC. Interested NSF program officers, as well as interested partners from NAE, ITEA, ASEE and CTTE, will be invited to have an opportunity to meet the fellows. During this meeting, the doctoral students will meet NCETE partners and have an opportunity to begin to establish relationships with each other.

NCETE Professional Development. Graduate Program team members took the lead in developing a meaningful professional development experience for NCETE member for the May 23-26, 2005, workshop. The emphasis of the design experience was on engineering design and the differences between engineering design and technology education design. Team members from the University of Georgia led Center members in an “Engineering Design Experience.” Over a period of three half-day sessions, NCETE team members learned how to design a projectile launcher following an engineering design process. To enrich the design experience, NCETE participants were taught the underlying mathematics and physics required to describe the projectile trajectory. Following the design experience, NCETE team members reflected on the effectiveness of the experience and ways in which it could be extended to pre-service teachers and 9-12 students. Team members from Utah State University developed two half-day experiences in engineering design through panel discussions and a tour of a local company.

Student Demographics. One of the goals of all NSF-funded Centers for Learning and Teaching is to diversify the instructional workforce in the STEM areas. The doctoral programs supported graduate and undergraduate students during the first year. The demographics of the graduate students were: one Chinese male and two white males.

2. Technology Teacher Education (TTE) Component

The TTE team consisted of investigators from Brigham Young University, California State University Los Angeles, Illinois State University, North Carolina A&T State University, and the University of Wisconsin – Stout. The TTE Director was Rod Custer from Illinois State University. The TTE team has participated in the following five face-to-face meetings: 1) September 15-16, 2004, at the University of Georgia, 2) November 3, 2005, prior to the Mississippi Valley Conference, 3) January 13-14, 2005 in Washington, DC, 4) March 31, 2005, prior to the ITEA Conference, and 5) May 23-26, 2005 at the summer workshop at Utah State. The TTE team has participated in teleconferences on October 19 and December 2, 2004, and February 24, 2005. E-mail was used regularly between face-to-face meetings. To further

enhance communication, in May 2005, an NCETE intranet site was developed.

Professional Development: Since September 15, 2004, each TTE institution has developed and delivered professional development workshops to regional high school teachers. The goal of the professional development workshops was to expose high school technology education teachers to the theoretical foundations of engineering and engineering design and to the hands-on applications of engineering concepts. As a first step toward establishing best practices for delivering engineering design and content through professional development, each institution developed their own experiences utilizing both technology education and engineering faculty. Participating high school teachers completed similar surveys at the conclusion of each workshop to help understand their learning experiences. Each institution openly shared the lessons learned (both successes and weaknesses) with their approach. Building on lessons learned, the TTE institutions will move toward a more common professional development experience during year two of the grant. Listed below are details of the professional development experiences at each institution.

Brigham Young University

- Teachers from partner schools were provided with 100 hours of professional development in order to develop knowledge and skills in engineering design and analytical and predictive processes in preparation for infusing such concepts into K-12 schools. The professional development consisted of lectures, demonstrations, field trips to exemplary schools, and lab design activities. Data were collected from participants regarding the quality and outcomes of the professional development.
- Five teachers were selected to participate in the professional development, however, one dropped out for personal reasons. The four teachers were white males. Four faculty members participated, all white males. Two graduate students and one undergraduate student participated. One was a female, one was Hispanic, one was Pacific Islander.
- A major challenge was scheduling the professional development dates as the teachers had various commitments in their districts (e.g., coaching, serving on district committees) that conflicted. Another challenge was the limited time to prepare the professional development series – more lead time was needed.

California State University, Los Angeles

- Teachers from partnership school district are being provided with 100 hours of professional development in three phases. The first phase was designed to lay a foundation with the math, science (mostly physics), and engineering design principles to prepare the teachers to infuse engineering design into their programs. The second phase involves the use of our seismic engineering design challenge as a module that the teachers will take back to their programs. The third phase involves fall follow-up meetings of the cohort. The plan was to consider the cohort to be one group over the five years. One group that will simply grow larger each year, rather than five separate cohorts. Data was collected from participants regarding the quality and outcomes of the professional development. The participants also developed a portfolio of resource materials collected in a project binder.
- There were seven teachers participating. Four of the participants are women and three are men. All of the men are white. Three of the women are white, and one was African-

American. There are five faculty members participating. Four are male and one was female. All are white.

- The only challenge incurred was that the district balked at the prospect of the teachers leaving the classroom for so many days during the spring. Since this was made clear early in the discussion, we scheduled all spring workshop dates on Saturdays. The teachers all agreed to this schedule, and it has worked extremely well.
- One graduate student has participated in the design of our engineering design challenge. Another graduate student will commence work on the project during our summer quarter.

Illinois State University

- Three members of the Illinois State University faculty have been involved in the professional development planning and delivery. These are Drs. Chris Merrill, Rodney Custer, and Michael Daugherty. Dr. Merrill has provided primary leadership for this effort.
- Micah Larson, a Masters level student has been involved in the professional development workshops. His primary role has been to serve as a recorder of activities and to make necessary laboratory arrangements.
- Additional participants have included Ty Newell (University of Illinois, engineering), Lenny Pitt (University of Illinois, computer engineering), Beverly Smith (Illinois State University, mathematics education), Carl Wenning (Illinois State University, science education), David Anderson (Illinois State University, philosophy and cognitive science), David Kennell (Illinois State University, robotic electronics), Ryan Brown (Illinois State University, graphics and kinematics), Kevin Devine (Illinois State University, robotics and graphics), Franzie Loepp (Illinois State University Emeritus faculty member, M/S/T), and Mark Sanders (Virginia Tech, engineering and technology education).

North Carolina Agriculture and Technical State University

- Teachers from partnership school systems have been provided with 100 hours of high quality professional development in order to learn engineering design and analytical and predictive processes in order to implement these processes into their technology education curricula and instruction. The professional development consisted of lectures and demonstrations followed by the solving of Engineering Design Challenges in a design and laboratory setting. There was also a focus on keeping teacher-participant portfolios and how to implement what was learned into the technology education public school classroom and laboratory. Data was collected from participants regarding the quality and outcomes of the professional development.
- There were six teachers participating. Five participants are African-American and one was white. Two of the participants are men and four are women. Four faculty members participated. Two are African-American and two are white. Three are male and one was female. Three GRA students participated. All are African-American. One was a female.
- Some students at both the undergraduate and graduate levels on NC A&T's campus were contacted to enroll in technology education programs, but success has only been documented at the graduate level.
- A variety of races, genders, and occupations were used as expert participants in this research which included the use of focus groups and a Delphi study.
- While none of the above described activity directly involved undergraduates, it did

happen at an HBCU. Demographic data has been collected on this activity as described above and should be captured by the NCETE project and its evaluators.

University of Wisconsin – Stout

- Three professional development workshops were conducted during Spring Semester, 2005. The remainder of the workshops will be conducted over the summer of 2005. The workshops provided the following content:
 - Explained the four fundamental purposes of the proposed case study associated with the summer workshop
 - Talked about potential themes that a pre-engineering curriculum should exemplify (e.g., pursuit of efficiency, predictive value of mathematics, grounding in science, model current technology)
 - Outlined potential engineering thrusts that the case study might emphasize (e.g., lean manufacturing, statistical process control, statistical quality control, automation, tooling).
 - Identified potential limitations that must be addressed to ensure implementation and replication across a variety of technology education settings (e.g., current curricula, existing equipment, laboratory limitations, time constraints, student capabilities in mathematics).
 - Brainstormed potential scenarios for implementing pre-engineering in existing technology education programs.
 - Examined the nature of engineering. More specifically, what distinguished engineering from other branches of technology.
 - Reviewed the scenario for the technical challenge (e.g., parts made in different locations, parts needing to fit together, making Toys for Tots, focusing on statistical process control, designing production tooling, integrating electronics, pursuing efficiency under the auspices of lean manufacturing, capitalizing on the concept of outsourcing).
 - Discussed curriculum/instructional design issues.
 - Conducted introductory training sessions on topics related to manufacturing engineering with participation from engineering faculty.
 - Reviewed and discussed potential resources for facilitating the scenario for a unit of instruction in the proposed case study.
 - Reviewed potential design criteria for developing and documenting the unit of instruction at the center of the proposed case study.
- The remainder of the UW-Stout professional development experience will be conducted over the summer of 2005. UW-Stout deliberately sought out its secondary school partners based solely on the talents of specific faculty members. The teachers in question have been extremely active in their state organization, innovative in their curriculum and instruction, and recognized leaders among their peers. Unfortunately, participation in NCETE added one more obligation to their already long list of professional activities. Consequently, the project came to realize there were limitations to the amount of time that these teachers can break away from their teaching responsibilities during the school year to consult with the project and engage in professional development activities.

Other TTE Activities: The TTE investigators identified an important need which is to describe in

detail the engineering outcomes for students in grades 9-12 who are part of technology education programs that deliver technological literacy but are improved by infusing engineering design and analytical methods into the curriculum. The outcomes will be informed by the Standards for Technological Literacy as well as the AAAS Standards for Technology but will be more narrowly focused on engineering and will contain more detail. A broad community will be surveyed as a first step in developing the outcomes. The broad community consists of at least the following: engineering educators, 9-12 technology teachers, technology teacher educators. The outcomes will guide the professional development experiences as well as assist with refocusing the pre-service technology education programs.

The TTE team has taken the lead in developing the “Engineering Design Challenges” (originally called Engineering Case Studies in the proposal). The Engineering Design Challenges will provide a specific engineering design problem including a practical problem scenario and linkages to relevant mathematical and scientific principles. The TTE team has developed a draft template for the Engineering Design Challenges and is working with the nine institutions in the development of specific design challenges. A quality control process has been identified to ensure the final Engineering Design Challenges that will be distributed via the NCETE web site are of uniformly high quality.

Student Demographics. One of the goals of all NSF-funded Centers for Learning and Teaching is to diversify the instructional workforce in the STEM areas. The five TTE institutions supported the following graduate students: six white males, four white females, two African American-American males, and one male Pacific Islander. One Hispanic male undergraduate student also received support from NCETE.

3. Research Component

The Research Team was composed of investigators from both the Graduate Program and the TTE Program. Graduate. The Research Director is Scott Johnson from the University of Illinois at Urbana Champaign. The Research Team met during the four regular face-to-face meetings of NCETE: 1) September 15-16, 2004, at the University of Georgia, 2) January 13-14, 2005 in Washington, DC, 3) March 31, 2005, prior to the ITEA Conference, and 4) May 23-26, 2005 at the summer workshop at Utah State. In addition, the Research Team gathered at the University of Minnesota for a focused meeting on research on February 18, 2005. E-mail is used regularly between face-to-face meetings. To further enhance communication, in May 2005, an NCETE intranet site was developed.

The following major activities have been completed.

- Developed a draft version of a comprehensive literature review on the topic of engineering and technology education. The document will continue to be developed and ultimately, it will be made available to the profession at large. This effort was primarily completed at UIUC.
- Developed a research framework for the Center in consultation with exemplary technology teachers, cognitive scientists, and our engineering partners. This framework

was organized around the three research themes of the center and included research questions within the categories of learning and cognition, engineering processes, creativity, perceptions, diversity and learning styles, teacher education/professional development, curriculum/instruction, diversity, change, student assessment, and teacher assessment.

- Developed a process and procedures for coordinating the NCETE research program. This involved the establishment of an RFP process to solicit and select research proposal for funding through the Center. A total of 13 proposals were submitted that requested a total of \$130,115 in funding. The proposals were reviewed and the highest rated proposals were considered for funding. Seven proposals were recommended for funding for a total of \$56K. All investigators received detailed feedback on strengths and weaknesses of their proposals.

4. Recruiting and Retention Component

NCETE established a task force to coordinate recruiting and retention efforts within the Center. Don Maurizio from CSULA led the task force with support from Craig Rhodes of NCA&T. The Recruiting and Retention Task Force was established because NCETE was concerned traditional means of identifying and attracting underrepresented groups to Center activities did not appear sufficient.

The Task Force generated a list of 68 campuses that offered undergraduate or master's degree programs in technology education. They contacted these campuses with an introductory phone call, send a mailer, and then followed-up with a phone call and/or an e-mail to each campus director. The results of this recruiting campaign were mixed and broke into the following response groups: some ignored us, some refused to assist (we were competing with their own doctoral programs for good candidates), some promised to assist but didn't, and some provided names. From this campaign, the Task Force identified 12 serious candidates that were then further recruited by members of the Graduate Program.

In order to assist with retention of the doctoral students, as well as the underrepresented students in the pre-service programs, the Task Force is preparing a seminar on this topic for the Fall 2005 meeting.

Major Findings: 2004-05

During the first year, NCETE focused most efforts on better defining and initiating research and education tasks. Some findings have surfaced within the Technology Teacher Education (TTE) Component and the Recruiting and Retention Component.

Technology Teacher Education

Investigators from Illinois State University noted a significant implementation issue in conceptualizing and planning professional development sessions without (a) a formalized professional development model and (b) a set of clearly defined secondary level engineering outcomes to guide the process. To have had these two components in place prior to planning and delivering professional development would have enhanced that quality of our work. However, our experience with the spring workshops served a valuable purpose of making us aware of the need for these two critically important elements.

Several TTE institutions were forced to address commitment and participation issues with their professional development teachers. At Illinois State, two teachers missed two sessions and were replaced with other teachers. The University of Wisconsin-Stout deliberately sought out secondary school partners that are extremely active in their state organization, innovative in their curriculum and instruction, and recognized leaders among their peers. Unfortunately, participation in NCETE added one more obligation to their already long list of professional activities. Consequently, UW-Stout delayed the remainder of their spring professional development experiences until summer. At North Carolina A&T State University, one of the partner school systems threatened to withdraw support unless the number of classes missed by the participating teachers was reduced. To solve this problem, more hours were designated for summer and some of the spring semester professional development contact hours (fourteen out of 38) were conducted online with a specially designed Web site. This same school system also required the project to pay for the substitute teachers needed to cover classes for its participating teachers. The same school system forbids the payment of stipends during the contractual period teachers were employed. That challenge was not overcome

Research Component

Faculty at the University of Georgia surveyed technology education professors (Wicklein, Gattie, Hill, and Thompson, 2005). Wicklein et al. found that 62% of university level technology education faculty indicated that they were currently teaching topics related to engineering or engineering design with 27% of their instructional time devoted to this subject. However, when the university faculties were asked to identify the amount of instructional time they gave to evaluating student work designated as analytical (mathematical) analysis only 16% was indicated. Furthermore, although the teacher educators perceived an engineering design focused curriculum as increasing the overall academic value of technology education (77%) they also identified that they needed to develop additional levels of mathematics and science skills if they were to adequately teach engineering design (63%).

Recruiting and Retention Component

The Recruiting and Retention Task Force identified the following challenges. First, the Task Force had difficulties recruiting non-traditional doctoral students. In these cases, there were “place bound” issues where people had put down significant roots and found it difficult to leave for 3 years. Second, the Task Force observed that NCETE did not have 100’s of students to choose from, the pipeline is not dry but it trickles. In some cases, offers “came out of the blue” – good candidates had been identified but had never thought of graduate school. For some candidates, NCETE needed more time to plant thoughts about a doctoral degree and did not have the luxury of time with this first cohort. Finally, some candidates really questioned the need for the PhD and could not see multiple opportunities upon completion of the degree.

James Dorward, Professor of Elementary Education, served as the internal evaluator for the program. His primary responsibility was to evaluate the effectiveness of NCETE management structure and strategies. He attended the February 22, 2005, meeting in Washington, DC, and the May 23-26, 2005, summer workshop. He also listened to several management team teleconferences.

Following the February 22, 2005, meeting he developed a post-meeting survey that was distributed on-line approximately two weeks after the meeting. Of the 20 participants, 75% completed and submitted the survey.

Overall, participants believe the meeting was important and useful. They were also satisfied with how the meeting was organized and carried out. Individual comments provided several implications and suggestions for future meeting agendas. The on-line, post-meeting survey was a cost-effective and efficient method of obtaining feedback.

Following the March 23-26 workshop, he provided the following comments.

This was a well-planned, well-executed meeting that reflects a level of maturity in management that speaks volumes for a young center. Most noticeable is how center management has continued to respond rapidly, and appropriately, to input from partners, stakeholders, and evaluators. While the tendency might be to recommend that center staff continue to do what they are doing, there are several possible enhancements to consider as the center completes its first year.

1. Encourage partners to begin planning for the quarterly meetings early to allow sufficient feedback and involvement from key stakeholders.
2. Strongly suggest that both TTE and graduate program committees develop explicit goals and objectives for their programs and courses with an eye toward formative evaluation.
3. A possible outgrowth of efforts to develop and disseminate program and course goals and objectives is a statement of beliefs about the relationships

Evaluation of the National Center for Engineering and Technology Education

Year One Report

**Naida Tushnet, Program Director
Jodie L.S. Hoffman, Project Director
Jaclyn Ziobrowski, Research Assistant**

June, 2005

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Introduction

WestEd is a nonprofit research, development, and service agency. Our goal is to enhance and increase education and human development within schools, families, and communities. WestEd, under contract with the National Center for Engineering and Technology Education (NCETE or Center), is conducting the external evaluation to assess the development, implementation, and impact of NCETE's activities. The goals of the Center are as follows:

- to develop a new cadre of leaders who are engaged in research, teacher preparation, and professional development with the knowledge and skill to integrate engineering into technology education,
- to conduct research in how students learn engineering and technological aspects; how students learn design and problem solving, assessment and evaluation strategies; and how best to prepare technology teachers,
- to refocus technology teacher education (TTE) to prepare increasing numbers of new teachers, representing the diversity of the nation, who can infuse engineering principles, predictive analytic methods, and design into the K-12 schools,
- to design and deliver professional development for practicing K-12 teachers to learn to infuse engineering principles, predictive analytic methods, and design into the K-12 schools,
- to develop methods for encouraging a diverse array of K-12 students to choose STEM careers.

Structure of the Report

In this report we provide a review of NCETE, how the Center is working toward achieving Center for Learning and Teaching (CLT) goals, and our evaluation activities and recommendations. The first section provides a brief overview of the Center activities and our evaluation activities. The next section presents the Center activities and how each of these activities is achieving CLT goals. The following section includes formative recommendations made during year one and changes or modifications the Center made as a result of our recommendations. Additionally, we provide a brief list of recommendations for how the Center might want to proceed in their continued work for

year two and beyond. This report concludes with our planned evaluation activities for year two.

Background

WestEd's evaluation plan is designed to assess annually the Center's impact and effectiveness, as well as its contribution to engineering and technology education research. Through cooperation with Center partners, WestEd will assess if the Center's work is fulfilling CLT's focuses of advancing the preparation of STEM educators and establishing a meaningful partnership among stakeholders. Our formative evaluation serves to inform Center leaders of partnership development and interactions, benchmarks on product development, and service activities and structures that warrant additional development, hence facilitating NCETE effectiveness. This section outlines WestEd's evaluation activities during the first year of the grant.

Numerous site visits were conducted during the course of the first year. The reverse site visit in Washington, DC (April 2004) aided in the proposal process. Attendance at planning sessions held in Athens, GA (September 2004), Washington, DC (January 2005), Kansas City, MO (March 2005), and Logan, UT (May 2005) produced valuable information about the structure, organization, and development of the Center. Contextual visits were made to the University of Georgia (September 2004), California State University, Los Angeles (January 2005), and Utah State University (May 2005). These visits assisted us in gauging the historical and existing relationship between engineering and technology education. While at Utah State University we also visited NCETE headquarters.

Outside of these in-person meetings, numerous informal conference calls and emails facilitated communication. Frequent conference calls were held with the Principal Investigator, Project Manager, and Teacher Technology Education (TTE) director. The content of these points of contact included planning for data collection and announcements during meetings, developing the TTE survey for professional development workshops, and providing formative feedback on our findings.

Our data collection, conducted in late spring 2005, included individual interviews with the six members of the management team and focus groups with the five TTE teams. The purpose of the interviews and focus groups was to assess the extent to which Center and individual goals were met during year one, to gather information about the role and impact of the different members of the Center, and to collect information about the accomplishments and challenges the Center members experienced during year one.

How Center Activities Fulfill CLT Goals

In this section, we will review NCETE’s activities and the extent to which they fulfill CLT goals. The Center’s work is categorized into five areas: communication and interaction, or “Center-ness;” Center Partners; Technology Teacher Education; Research; and Graduate Student work. Under each of these areas, we discuss how Center work in the first year of funding fulfills the six primary CLT goals: (1) Advancing the preparation of STEM educators, (2) Establishing a meaningful partnership among education stakeholders, (3) Partnership development and interactions, (4) Benchmarks on product development, (5) Service activities, and (6) Research. Please note that each NCETE area does not necessarily address each CLT goal (Table 1).

Table 1

Summary Table of CLT Goals and Center Activities

<u>CLT Goals</u>	Center-ness	Partners	TTE	Research	Graduate Students
Advancing the preparation of STEM Educators		×	×	×	×
Establishing a meaningful partnership among education stakeholders	×	×	×	×	×
Partnership development and interactions	×	×	×		×
Benchmarks on product development			×	×	×
Service activities	×	×	×	×	×
Research	×		×	×	

“Center-ness”

With a group such as the National Center for Engineering and Technology Education, a nationwide organization involving nine institutions of higher education, approximately 30 professors, and spanning two academic disciplines, it takes a tremendous effort to ensure one overarching voice is represented. The Center-ness of NCETE is crucial to ensure collaboration, consistency, and intended national effect.

Without Center-ness, each partner's work would become introverted and self-serving, and the affected population would be limited to the scope of each regional academic institution. In this context, Center-ness encompasses both internal and external qualities. Internally, Center-ness refers to the communication and interaction of the partners. Externally, Center-ness refers to communication and interaction, but also entails a level of public relations and academic credibility. In addressing how NCETE's Center-ness fulfills the CLT goals, both internal and external efforts will be addressed as appropriate.

The design of NCETE as a national center is to establish a meaningful partnership among education stakeholders. Center work involves engineering and technology education professors, in-service and pre-service technology teachers, graduate students, professional society partners, industry partners, high school level technology students, and other peers from the engineering and technology education arenas. Some of these partnerships are stronger than others, but in the first year, each of these stakeholders was introduced, if not influenced by NCETE via its TTE workshops, Research grant opportunity, fellowship program, publications, appearances at professional society conferences, and website.

The strongest and most meaningful partnership established thus far is among the internal Center partners themselves. The various meetings of the partners culminated in the Summer Conference held in Logan, UT in May 2005. The Conference provided an opportunity to advance partners' commitment to the Center. For example, in one activity, engineers and technology educators worked in teams to complete a proposed engineering design challenge, therefore putting into practice the combination of the two disciplines the Center was developed to achieve. This single activity transformed concept into reality and helped to solidify internal Center-ness as the cross-discipline, cross-institution teams communicated and collaborated to achieve an end goal. The strength of the internal partners will help Center progression.

In addition to the strong relationships built among the Center partners, Center work thus far also established relationships with academic peers, graduate students, and in-service and pre-service teachers.

NCETE's partnership development and interactions involves collaborating with professional society and industry partners, as well as establishing a presence at industry conferences. Partnership development is a recent effort spearheaded by the Principal Investigator (PI) and co-PI. When the Center was initially formed, the emphasis of their work was placed on Center organization and development. As it currently functions, the Center is in a position to legitimately warrant mutually beneficial partnerships with professional society and industry partners. At present, NCETE has contacted a number of

partners such as the American Society for Engineering Education (ASEE), Council on Technology Teacher Education (CTTE), the Center for the Advancement of Scholarship on Engineering Education (CASEE), and Project Lead the Way. However, the details of what the partnerships entail and how they are mutually beneficial is still unclear. The benefits of an association with established professional societies and industry partners as well as publicity is important for NCETE's external Center-ness; however, establishing purpose behind the partnerships will lead to productive, institutionalized interactions. A second effort the Center put forth to establish external Center-ness involves a Center presence at the annual International Technology Education Association (ITEA) conference. Center partners donned NCETE apparel and erected a NCETE booth to publicize the Center and its activities to their academic and professional peers. This level of activity, which included partners wearing NCETE shirts and manning the booth together, not only promotes internal Center-ness but it also puts forth a united front to industry peers.

In the future, we would like to see a stronger, more significant partnership develop between the Center and professional society partners, industry partners, and high school level students. In addition, we would like to see the Center continue to stress the importance of contextualizing the work done by each partner institution as efforts put forth primarily by NCETE in collaboration with each institution.

The Center instituted a number of service activities in the first year of operations to promote Center-ness such as awarding Research funds, beginning its fellowship program, and conducting TTE workshops for in-service technology teachers. The NCETE Research team circulated a request for proposals (RFP) among students and professors at partner institutions for the development of research plans aligned with NCETE goals. Fourteen proposals were submitted for approximately seven awards. This initial RFP process helped legitimize the Center as a hub for research involving learning and teaching in engineering and technology education. In the future, students and professors looking to fund their research plans will think about the Center as a potential funding source.

The fellowship program is similar to the Research program in that they are both new resources for engineers and technology educators. In the first year, recruitment for potential NCETE fellows garnered 32 applications for 12 NSF-sponsored positions.¹ As

¹ Fourteen Fellows were accepted; however, NSF only provided funding for 12 Fellows. The other two Fellows are being sponsored by their individual Universities, but are considered NCETE Fellows.

the publicity and validity of the Center grows, especially in terms of its research and the caliber of its graduates, there will theoretically be an increase in the quality of its pool of candidates.

A third service activity implemented that promotes external Center-ness is the TTE workshops for in-service teachers. This program exposes the Center to school district partners and classroom teachers, a number of whom are alumni of the TTE programs, as well as other faculty members at each TTE institution, primarily engineering professors who aid in delivering the workshop content. Center exposure to these stakeholders is important; however, emphasis must be placed on the effort as a national Center endeavor versus an effort put forth solely by any one institution's TTE department.

Center-ness in terms of research advancements is a slower process with effects that cannot be fully realized in the first year of operations. However, Center partners are planning to accomplish long-term efforts such as the NCETE yearbook, increasing their efforts to publish articles, and completing the website as a research resource. The NCETE yearbook, which will be developed in association with CTTE, will be a culmination of research articles related to Center goals and is scheduled for release in 2008. This yearbook will be available to center partners and CTTE members among others, and has the potential to be used as a research reference and classroom textbook. Furthermore, many Center partners already published articles about the Center and its aims in a number of industry journals. The next step is to publish research findings sponsored by the Center, therefore contributing to the validity of the Center as a national resource for engineering and technology education. The website will also serve as a hub for research information. Once the Research team's literature review and research articles are uploaded to the Center website, it will become a primary source for information on engineering and technology education. When this is accomplished, publicizing the website will be necessary so academic and industry peers will immediately think of NCETE as a source of answers for their research questions.

In general, NCETE's efforts to establish internal and external Center-ness are solid. Center partners are interacting consistently and various measures to ensure communication and collaboration are functioning smoothly. Partners are utilizing the right channels to publicize the Center to all appropriate stakeholders. In general, efforts discussed during Center meetings to establish Center-ness are realized; however, there is still a question as to how well these efforts are translated at each individual institution. It will be important for Center leaders to consistently emphasize Center-ness as NCETE grows in scope and scale.

Partners

NCETE is working to develop partnerships with two categories of stakeholders, professional society and industry partners, and school districts. As mentioned above, NCETE made contact with and established preliminary partnerships with four professional societies, ASEE, CTTE, CASEE, and ITEA; and one industry partner, Project Lead the Way. School district partners were established during the proposal and planning phase of the Center. Each TTE university (Illinois State University, North Carolina A&T University, University of Wisconsin, Stout, Brigham Young University, and California State University, Los Angeles) is partnered with at least one local school district. NCETE would eventually like to work with grades K-12 in each school district; however, the partnership is currently limited to the high school level, grades 9-12.

The Center's TTE group is presently working with school district partners to advance the preparation of STEM educators. Each TTE institution has at least one technology teacher from its partner school districts enrolled in professional development workshops. The district-level partnership enabled these teachers to take time from their regular school day to attend the workshops. The partnership is also making district and school level administrators aware of Center aims and activities.

In theory, the school district partnerships sound promising; however, in practice the partnerships seem to be solely between the individual teachers attending the workshops and the host TTE institution. The Center and each TTE institution should forge a stronger relationship with administrative decision makers as their influence can be crucial to ensuring implementation at the classroom level and their insight can make way for additional opportunities for collaboration.

Another area of concern is the number of district partners with which each institution works. Some of the partner universities are working with teachers from over three different school districts. The breadth of influence and exposure is alluring. However, the depth of these partnerships, which can influence impact and institutionalization, is questionable. One TTE institution has a different level of partnership with its partner school district – one that seems to be manageable and may prove to have a deeper influence. This institution is partnered with only one large school district that is currently undergoing a systemic change in its high schools. Three of the district high schools are implementing a school reform that would vertically categorize grade 9-12 students into separate small learning communities, each of which will fall under a specific academic theme. The TTE institution is working exclusively with the teachers from the technology-themed “communities,” which will ultimately

institutionalize the Center's engineering and technology education work into their curriculum. We understand this is a unique situation. However, this partnership seems the most likely to have an influence on educator preparation.

NCETE and TTE leaders are attempting to establish meaningful partnerships among the society and industry partners and K-12 partners. However, as we discussed previously, the depth of these interactions is still unclear and/or still in development. Center partners experienced success at ITEA in terms of exposure and there are future plans for partners and Center fellows to give presentations on behalf of the Center. However, the Center's partnership with ASEE and CTTE remains undefined. NCETE's work with Project Lead the Way sounds very promising, and the details of the partnership will be better established in the coming year. And as we discussed above, the partnerships between the TTE institutions and school district partners should still be considered in development. Center partners are in a solid position to forge meaningful partnerships with these and other potential partners as engineering and technology education is a popular industry issue. Emphasis must now be placed on deeper, mutually beneficial interactions.

The only NCETE service activity involving partners is the TTE group's professional development workshops. This work is making progress in achieving NCETE and TTE goals. However, we have yet to see how other NCETE partners will become involved in Center service activities such as the fellowship program or K-12 classroom activities. This may become clear once the current partners better define their respective responsibilities, and other affiliations, such as the budding partnership with Project Lead the Way, are further developed. It may also be helpful for Center leaders to pursue additional partnerships with a specific, mutually beneficial service goal in mind.

NCETE's partnership development activities show great potential. Center partners will be better able to fulfill CLT goals if they work towards defining how their current and future partnerships can benefit the Center. Center partners are also more likely to develop meaningful, institutionalized partnerships if they pace their partnership development process and focus on the depth, and therefore sincerity of the alliance. However, the enthusiasm of the Center partners to forge partnerships serves as a strong catalyst for achieving NCETE's partnership goals.

Technology Teacher Education

The TTE group fulfilled its goal of providing professional development workshops to in-service teachers in the first year of the CLT grant. Each TTE institution designed

and delivered individualized workshops guided by overarching educational principles established by the group at the beginning of the Center's formation. This lightly managed approach proved beneficial in accommodating the styles of the individual TTE institutions. However, the groups also experienced a number of challenges they plan to remedy for next year's workshop series.

As we discussed in the *Partners* section above, the TTE group is directly addressing the CLT goal of advancing the preparation of STEM educators. Each institution is seeking out in-service high school technology educators to participate in a series of specialized workshops that will help them to incorporate engineering principles into their pedagogical practices. The institutions are also intending to alter their current technology teacher education programs to embody the cross-discipline ideals of NCETE. The work being done for the in-service teachers is very clear; however, the changes to be made to each university's current program is not as transparent. Each TTE partner institution could benefit from developing formal plans that outline how they intend to institutionalize these curricular changes. Strengthening the focus on transforming teacher education programs while developing in-service teachers will have a profound and immediate impact on preparing a new generation of STEM educators and, eventually, future generations of technologists.

Partnership development among TTE stakeholders was also addressed in the *Partners* section above. The TTE partners would benefit from strengthening their school district partnerships as well as developing a plan to utilize the Center's professional society and industry partners in their work at the high school and/or collegiate levels. Some TTE institutions use local industry partners in their professional development workshops; however, this practice should be replicated, and the partnerships should be expanded across all five TTE schools.

Each TTE institution; however, has seen great partnership development on their individual campuses as a result of the TTE workshops. The TTE partners received some guidance from the Graduate partner engineering specialists, but these partners are not available to aid in developing the in-service and pre-service teachers. As a result, the TTE partners sought engineering specialists on their own campuses, resulting in new cross-department, cross-discipline collaborative relationships. These new relationships not only served to introduce NCETE to other industry professionals, but they also enforced the purpose of NCETE and demonstrated to in-service and pre-service technology teachers the reality of the cooperation between two previously separate disciplines.

The TTE group did not realize any benchmarks in product development in year one. Each TTE institution designed its own professional development workshop series, but

these workshops are too disparate to be considered a replicable NCETE product. Once a series of best practices gleaned from each institution's workshop format is determined and aligned with the Center's TTE aims, a "NCETE way" of delivering quality, engineering-infused professional development for in-service technology educators can be established and replicated.

A second NCETE product with the potential for replication involves the set of engineering design challenges the Center is presently developing. These challenges are intended to provide hands-on engineering and technology experiences for high school students. The engineering design challenges are intended for use by the in-service and pre-service teachers at each TTE institution. However, there is potential for the development of a NCETE engineering design challenge curriculum package. Center partners would need to apply for additional funding to pursue the development of this product.

The TTE workshops for in-service technology teachers met varying levels of success at each TTE institution. Some institutions were able to complete their series of five spring workshops before the close of the academic year while others only completed two; some centers experienced consistent participation by their workshop attendees while others lost participants or had participants who could not get the time away from the classroom; and some were able to include engineering faculty from the start while other institutions had difficulty identifying and committing engineering faculty to assist in instruction. Each institution also embraced different styles of instruction that ranged from "drill and kill" to unstructured discussion sessions.

The variation in each institution's style proved to be helpful; however, in developing a series of best practices each institution can learn from one another. Examples of best practices we identified include working with teachers on their current curricula to infuse engineering principles, thereby making it easier for them to put what they learn into practice, and providing each participant with a comprehensive binder of materials to use as a reference manual in their own practice. In another example, one institution invited its pre-service teachers to attend the workshops to benefit from the insight of practicing teachers. Regardless of the differences, each TTE institution agreed that, in retrospect, a planning year would have benefited their professional development delivery processes. Each partner also agreed upon the ultimate goal of the workshops – that eventually, the engineering component of technology education will filter down to the classroom level and influence, if not inspire, future generations of technologists to think differently about their work.

A critical research effort the Center must prioritize is establishing a list of student outcomes or standards with regard to engineering and technology education. Once these student outcomes are developed, the TTE partners can determine what they need to teach their in-service and pre-service teachers so they may guide their students to mastery. And finally, once teacher outcomes are developed, TTE partners can develop a pedagogically sound method of teacher professional development. The TTE group attempted researching the necessary student outcomes; however, this endeavor became larger than initially anticipated. At the time of our last contact with TTE group members, one had submitted an RFP to the Research group to conduct this research and had yet to hear if his proposal had been funded. We encouraged the TTE team to pursue additional funding, if necessary, to accomplish this research. Without establishing an agreed-upon set of student standards endorsed by the Center, the TTE group is blindly guiding their workshop participants and teacher candidates.

The TTE group is moving forward in achieving its goals. The team is accepting of formative feedback. Each individual TTE institution is constantly thinking about its practice and listening to one another to improve the work. The group's primary setback at this point is the development of NCETE student outcomes, although TTE partners are continuing research efforts in this area.

Research

The Research partners accomplished three planning tasks in the first year of the grant – setting the research agenda, conducting a comprehensive literature review, and conducting the Center's first request for proposals (RFP) process. Once these tasks are fully completed, the Center will be in a solid position to begin referring to itself as a primary source of knowledge about engineering and technology education.

NCETE's three research themes revolve around advancing the preparation of STEM educators: (1) How and what students learn in technology education, (2) How best to prepare technology teachers, and (3) Assessment and evaluation. The Center's RFP specified that all proposals should address these research themes. The NCETE RFP review board selected seven proposals that fell in line with the Center and its research goals. The research conducted by the selected researchers should contribute to advancing the preparation of STEM educators. However, one area of research the Research partners should consider a priority as it would not only contribute to the CLT goal, it would also benefit the development and reputation of the Center itself: the Research and TTE partners should cooperate to develop a set of student outcomes for engineering and

technology education. One TTE partner submitted a proposal requesting funding to accomplish this task; however, at the time of this report, we are unaware of the status of that proposal.

The Research team's RFP process also serves as a method of establishing a meaningful partnership among education stakeholders. The RFP was circulated among all faculty and students associated with the nine NCETE partner institutions, thereby creating a relationship with stakeholders in the higher education arena that extends beyond the Center management and leadership teams. Academics in the engineering and technology education fields will now think of NCETE when they have research goals in need of funding. Conversely, these individuals will also think of NCETE when they are seeking current and reliable research on engineering and technology education. In the next RFP process, Center leaders will have to decide if they want to open the NCETE RFP process to outside institutions, or continue to fund only individuals associated with the Center and its partner institutions.

Product development for the NCETE Research team will be accomplished next year. Research partners plan to use the NCETE website as a hub for disseminating findings from the literature review, as well as their research findings. This web-based resource will be available to all industry stakeholders interested in learning about the latest research in the combined discipline of engineering and technology education. Format and access details are still in development. However, this function of the website is intended to go live in the second year of the grant. Center leaders will need to strategize on both maintaining the website to keep the latest research uploaded, as well as properly publicizing the tool to achieve maximum exposure and use. This product will likely be the quickest method by which NCETE will gain national credibility and respect within the engineering and technology education arenas.

The Research team's RFP process was the primary service activity accomplished this past year. In general, the process went smoothly, garnering fourteen research proposals for seven awards. The RFP is a six-page document thoroughly explaining the requirements of the content, submission, and review. All submissions underwent an initial screening process that determined completeness and alignment with Center goals. Qualifying proposals were then distributed among the Research partners to undergo a secondary screening process, which involved two Research partners reviewing the proposal in detail and each completing an assessment form. The research team then met to discuss the proposals according to the information provided on the assessment forms, and as a group, made their final selections. Decision letters were scheduled for delivery in

June. According to the Research director, each recipient will be assigned to a Research committee member from the awardee's institution as a point of contact.

The Center's RFP process is well thought out and the collaborative nature of the selection process seems thorough and fair. The current priority for the Research team is establishing a process to monitor the progress of the research.

The Research team is making steady progress in fulfilling both the CLT's and the Center's research goals. Making this research available to the public will be an important next step. Center and Research leaders will need to continue pursuing the Research goals while vigilantly maintaining the Center's integrity as a credible source of current and applicable research.

Graduate Student work

The NCETE Graduate Student team focused primarily on the Center's fellowship program and developing the four core courses the fellows will be enrolled in over the next two years. Each of these tasks required a tremendous amount of planning coupled with strict deadlines.

The NCETE fellowship program serves to advance the preparation of STEM educators, but it also intends to advance the preparation of STEM leaders. The fellowship program will prepare engineers and technologists to understand each other's disciplines while strengthening their backgrounds in engineering analysis, problem solving, and design. The fellows selected come from a wide background – some were formally trained as technologists while others have engineering backgrounds, and some of the fellows are coming straight from master's programs, while others chose to leave their teaching and industry careers to pursue the NCETE PhD program. These fellows will be the first to receive a formal training under the merged disciplines of engineering and technology education. It will be important for the NCETE Graduate Student team to monitor their progress to ensure their educations are indeed guided by NCETE aims, and they are also taught the necessary skills to become effective leaders upon graduation.

In creating the NCETE fellowship program, the Center is laying the groundwork to establish a meaningful partnership among education stakeholders, especially among engineers and technology educators in higher education. The new fellows seem enthusiastic about the program. The fellows will be able to communicate with and learn from both professors of engineering and professors of technology education, and conversely, Center partners will benefit from the insight the cohort one fellows can provide as student pioneers in the field of engineering and technology education. The first

cohort's experiences will help shape the fellowship program for future fellows and even other similar PhD programs. The four Graduate institutions must keep open lines of communication to fully benefit from this mutual learning process.

Center and Graduate Student partners have many strategies planned for partnership development and interactions between the fellows and professors from all the Graduate institutions. The fellows will first gather in August 2005 in Washington, DC for an informal introduction and meeting. Then, they will return to their respective universities and begin their studies. Each semester for the next two years, the fellows will take one core NCETE course. Each institution will host one of the courses while the other fellows are enrolled via a web-based system. Lectures will also be recorded and available to the fellows. In Fall 2005 the fellows will take a Cognitive Science course hosted at the University of Illinois; in Spring 2006 they will take Engineering Modeling hosted at the University of Minnesota; in Fall 2006 it will be Engineering Design I hosted at the University of Georgia; and finally in Spring 2007 the fellows will take Engineering Design II hosted by Utah State University. In addition, fellows will attend seminars; however, the frequency and content of these seminars is not yet determined, and the fellows will not interact with their peers from other universities during these seminars. Though the Graduate Student partners are confident in this course delivery process, equitable learning and the lack of interaction associated with distance learning raises some red flags. As we mentioned previously, the Graduate Student partners will need to closely monitor the fellows to ensure they are all benefiting from the course content and that best practices at any one institution are communicated, translated, and implemented at each institution. The fellows will also take part in a listserv and meet at various times throughout the year when the NCETE team gathers, such as at the annual ITEA conference and at the NCETE Summer Conference. With regard to partnership development and interactions, the Graduate Student team will need to constantly encourage the fellows to communicate with one another cross-institutionally. A unique and potentially powerful feature of the NCETE fellowship program is the nationwide cohort of fellows. However, the fellows need to understand and feel that they are indeed a part of a nationwide cohort and national center, and not just doctoral candidates of one university.

Product development for the NCETE Graduate Student team primarily rests with the development of the four core courses. The content and sequencing of the courses are determined; however, there is some concern regarding the fellows' background knowledge of math and science and their ability to follow the rigorous engineering content. The Graduate Student team decided to designate some seminar courses as

background sessions in math and science for the fellows; however, details have yet to be determined. The deadline for task completion is set and students begin their first core course and seminar sessions in the fall. Course adjustments are likely after the first semester of delivery, but by the time the second cohort of students completes the series of core courses, the Center will have a solid doctoral curriculum for others interested in pursuing a PhD in engineering and technology education.

The primary service activity conducted in year one was recruitment. This process proved to be challenging and a bit chaotic when it began. The recruitment process began late in the academic year, and it seemed that Center partners were scrambling to find candidates before application deadlines at their respective universities. Some Center partners were already accepting candidates before a pool of potential fellows had been developed and they could determine the best group of candidates. Opinions varied on the requirements needed for entrance into the fellowship program. Further, the process lacked an emphasis on recruiting qualified candidates from underrepresented backgrounds. However, once these discrepancies were recognized, Center and Graduate Student leaders reined in the recruitment efforts, standardized the recruitment process, and began seeking out qualified and desirable candidates for the first cohort. Ultimately, the Center was successful, fielding 31 applicants for 12 positions. The Center partners are very pleased with the quality of their doctoral fellows and are especially proud that 43% of the fellows represent underrepresented groups. Now, Center leaders will need to strategize on a recruitment process for cohort two's fellows. This second effort should be smoother due to the lessons learned from recruiting experiences in year one.

Accomplishing the dual responsibilities of accepting a qualified and diverse cohort of doctoral students, and developing four courses intended to prepare future engineering and technology education leaders in a manner aligned with NCETE goals are tremendous. The recruitment process in year one proved to be very successful for the Center. Center leadership and the Graduate team should begin strategizing about recruiting Cohort two fellows in Fall 2005 to avoid the rush and panic they experienced this past year. Course development is a slower process and will be an ongoing practice of development and refinement. The Graduate director should closely monitor course progress as well as fellow participation and understanding in the first year of course delivery to ensure the aims of the Center's Graduate program are fulfilled and fellows are not falling behind.

Year One Formative Recommendations

The following section includes recommendations made during year one, and changes or modifications the Center made as a result of our recommendations. Our formative evaluation serves to inform Center leaders of partnership development and interactions, benchmarks on product development, and service activities and structures that warrant additional development, hence facilitating NCETE effectiveness.

From the beginning, the Center has been receptive to suggestions from WestEd, the National Science Foundation, and others with experience in the areas of engineering and technology education. For example, the Director of the Center for the Advancement of Scholarship on Engineering Education (CASEE), who is also a member of their Advisory Board, requested the Center make a distinction between their Center and Project Lead the Way and to evaluate the nature of the relationship with Project Lead the Way. Based on this recommendation, the management team contacted Project Lead the Way and a partnership is under negotiation.

An initial recommendation made by WestEd at the reverse site visit was for the Center to establish distinct roles for the members of the management team. Based on this recommendation, Center leaders have since clearly identified a central management team and leadership roles, such as TTE director, Research director, Graduate Program director, and Recruiting and Retention Task Force lead.

Another preliminary recommendation was to emphasize building Center-ness, as this is crucial to the development of the Center and to achieving the intended outcomes. Recognizing the importance of this for a nine-university collaboration, the management team helped build Center-ness by creating and distributing customized items, such as polo-style shirts and pens with the Center logo, organizing team-building activities, and encouraging personal communication among the partners.

As the Center began recruiting PhD fellows, the Center's thought was to select candidates because they are willing to enroll in the PhD program, not because the candidates necessarily are a good match for the program. WestEd noticed deficiencies in this recruiting process. For example, a question arose as to whether or not the Center should accept applications from candidates who never took the Graduate Record Examination (GRE). In another example, some of the universities were already informing candidates they would be selected in the program without reviewing all potential applicants and then making the decision. WestEd recommended the Center change its protocol to recruit only those candidates who fit the requirements of the Center and to be more selective in their recruiting. Based on this recommendation, efforts were made by

Center leaders to create a formalized protocol for selecting fellows. The Graduate Program director and the Recruiting and Retention Task Force lead both made attempts to recruit non-traditional students by visiting other university campuses, hosting a booth at the ITEA conference, mailing information to schools with engineering and technology education programs, and following up with telephone calls to individual students.

As the TTE group was in the planning stages of the professional development workshops, WestEd made the recommendation to include time for reflection and evaluation in their workshops. It was suggested they develop a formative evaluation with the purpose of collecting information on the experiences of the participants. In response to this recommendation, the TTE director worked with WestEd to develop surveys assessing participants' opinions and satisfaction with the workshop content and format. Each of the five TTE sites created individualized evaluation tools. These individual site assessments, which include primarily open-ended, qualitative items, provide formative feedback to the workshop facilitators. WestEd also created an assessment, containing primarily quantitative items, to provide summative feedback for all five TTE sites. WestEd's first assessment will be conducted at the conclusion of the summer 2005 workshop experience.

Recommendations

In this section, we offer recommendations to support the success of NCETE. These recommendations are based on findings from this report.

Center-ness

- Continue to stress the importance of contextualizing the work done by each partner institution as efforts put forth by NCETE.

Partners

- Develop a stronger, more significant partnership between the Center and professional society partners, industry partners, and high school students by pacing the partnership development process and focusing on the depth, and therefore sincerity, of the alliance.
- Define how current and future partnerships can benefit the Center.

Teacher Technology Education

- Have each TTE institution submit a detailed work-plan outlining its professional development workshops at the beginning of the academic year describing the intended outcomes for the year and the means of achieving those outcomes.
- Develop a “NCETE way” of professional development by composing a list of best practices from each of the five TTE sites.
- Follow-up with the workshop participants by observing how they are implementing the material they learned and/or scheduling a refresher workshop sometime during the school year.
- Encourage all TTE institutions to strengthen school district partnerships as well as develop a plan to utilize the Center’s professional society and industry partners in high school and/or collegiate level work.

Research

- Make the identification of 9-12 technology student outcomes a priority.
- Maintain the website to keep the latest research uploaded, and properly publicize the website so academic and industry peers will immediately think of NCETE as a source of answers for their research questions.

Graduate Students

- Monitor graduate student progress to ensure their educations are indeed guided by NCETE aims and they are taught the necessary skills to become effective leaders in engineering and technology education.
- Monitor course progress as well as fellow participation and understanding in the first year of course delivery to ensure the aims of the Center’s Graduate program are fulfilled and fellows are not falling behind.
- Begin strategizing and planning for year two graduate student recruitment during fall semester 2005.
- Keep the first cohort fellows united to sustain retention. Prioritize efforts to ensure fellows consider themselves to be part of a nationwide cohort and national center.

Year Two Evaluation Activities

In this section, we will detail our planned evaluation activities for year two. The data collected in year one is primarily qualitative, consisting of interviews and focus groups. In year two, in addition to interviews, focus groups, and document reviews, we also will collect quantitative data in the form of surveys.

We plan to attend the October 2005 fall planning session at California State University, Los Angeles. We also plan to attend the winter 2005 and spring 2006 planning meetings and the 2006 Summer Conference.

Over the course of year two, we will follow up with the TTE group with inquiries about the professional development workshops. Our evaluation will consist of interviews and surveys. We will survey the TTE professional development workshop participants on their growth in engineering knowledge and use of workshop materials, as well as collect background demographic information. Beginning in spring 2006, we will survey the students of the TTE workshop participants on their knowledge of and interest in STEM subjects.

Although we plan to monitor the progress of the TTE group, our main focus for year two will be on the PhD fellows and the Graduate Program's core courses. For our evaluation of the Graduate Program, we intend to collect qualitative data in the form of interviews and focus groups, and quantitative data in the form of surveys. The surveys will assess the PhD fellows' interest in pursuing careers in education and their experiences in the PhD program.

Our first case study will begin in year two. The NCETE management team will select one Graduate institution and one TTE institution in the same regional area for our first case study site visit. During this visit we plan to conduct a number of qualitative activities including observing a NCETE Graduate core course, interviewing the on-site fellows, observing a TTE workshop, and interviewing the workshop participants. During year two, we will also be conducting document reviews of the Center's research contributions and progress in the field of STEM education.